REMARKS

Claims 1-11 are currently pending in the subject application, and are presently under consideration. Claims 1-11 are rejected. New claims 12-17 have been added. Favorable reconsideration of the application is requested in view of the amendments and comments herein.

I. Rejection of Claims 1-5 Under 35 U.S.C. §103(a)

Claims 1-5 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,363,087 to Rice ("Rice") in view of U.S. Patent No. 6,751,388 to Siegman ("Siegman"). Withdrawal of this rejection is respectfully requested for at least the following reasons.

Claim 1 recites a multimode fiber having a core incorporating radially dependent amounts of doping materials to provide a desired refractive index profile and a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, wherein light launched into an end of the fiber is subject to higher Raman gain along the optical axis, which promotes lower order modes and discriminates against higher order modes. The Office Action dated October 27, 2005, asserts that Rice teaches "a core including doping materials to provide a desired refractive index profile and a desired Raman gain coefficient profile." (Office Action dated October 27, 2005, page 2, citing Rice, col. 3, ll. 53-55). Representative for Applicant respectfully disagrees with this assertion.

The section of Rice cited by the Examiner states, "For germano-silicate single mode fiber cores commonly used in telecommunications, the gain reaches a peak value for an energy shift of about 500 cm^{-1}, though this value can be widely adjusted through composition." (Rice, col. 3, ll. 53-55). Rice specifically states that germano-silicate fibers are commonly used in telecommunications, and accordingly suggests that germano-silicate material is simply the material used to construct optical fibers. As is known in the art, optical fibers can be doped to provide optical gain (see, *e.g.*, Rice, col. 1, ll. 19-21, Siegman, col. 7, ll. 48-52, Present Application, page 1, ll. 15-19), or to provide changes in refractive index (see, *e.g.*, Siegman, col. 6, ll. 36-41). However, Rice is silent as to germano-silicate fibers being doped to provide a desired Raman gain coefficient profile. In addition, Rice specifically teaches optical fibers that

are un-doped (Rice, col. 6, ll. 66-67). That Rice teaches optical fibers made of germano-silicate material does not provide a teaching or suggestion that the optical fibers are doped to provide a desired Raman gain coefficient profile. In addition, Rice discloses a Raman pump core, which receives a focused pump beam that that becomes evenly distributed in the Raman pump core to provide SRS gain for a signal wave in the single mode core (Rice, col. 3, ll. 40-50). Rice further teaches that "Stimulated Raman Scattering (SRS) is a process that occurs at a point, and any point within an illuminated volume will exhibit Raman gain." (Rice, col. 1, ll. 40-42). Accordingly, simply because the Raman pump core is subjected to the SRS process does not, by itself, suggest that the optical material is doped to provide a desired Raman gain coefficient profile. Therefore, Rice provides no teaching or suggestion of doping materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, as recited in claim 1.

The addition of Siegman does not cure the deficiencies of Rice to teach or suggest doping materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, as recited in claim 1. Siegman discloses doping a dual clad single or multi mode fiber with rare earth metals such as Erbium (Er), Ytterbium (Yb), and Neodymium (Nd), to create a radial doping profile in order to guide a particular transverse propagation mode or selected group of transverse propagation modes. The Office Action dated October 27, 2005, relies on Siegman to teach "a multimode optical fiber which uses radially dependent amounts of dopant material to affect the gain and the refractive index," and that "it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the optical fiber of Rice with the doping profile of Siegman in order to guide the lowest order, or selected lower order modes, in the guide to obtain high output powers." (Office Action dated October 27, 2005, pages 2-3, citing Siegman, col. 4, ll. 40-47 and col. 3, ll. 25-32). Representative for Applicant respectfully disagrees.

The Siegman reference teaches away from using doping materials to create a desired Raman gain coefficient profile, because it recognizes that the SRS process should be avoided. Siegman states that, when designing an optical fiber, the core diameter must be chosen such that

the laser power intensity (watts/mm^2) does not exceed a certain maximum value, otherwise Stimulated Raman Scattering occurs which converts the laser light to other wavelengths. (Siegman, col. 2, ll. 16-30). To remedy this, Siegman teaches:

> "...the diameter D of core 12 (or twice the radius, D=2a) is selected between 100 to 200 μm and thus only the fundamental mode is guided. To obtain the desired high output power in mode 28, the intensity of radiation per unit cross-sectional area of core is kept low. This prevents the onset of Raman and Brillouin effects." (Siegman, col. 9, ll. 57-63).

Siegman therefore teaches away from the use of Stimulated Raman Scattering to produce gain in an optical fiber. Accordingly, absent improper hindsight, there is no motivation for one of ordinary skill to combine the teachings of Siegman with the teachings of Rice to achieve the invention of claim 1. Accordingly, neither Rice nor Siegman, individually or combined, teach or suggest claim 1. Withdrawal of the rejection of claim 1, as well as claims 2-5 which depend therefrom, is respectfully requested.

Claim 2, which depends from claim 1, recites that the core incorporates radially dependent amounts of selected transparent oxides to provide a radially dependent control of the Raman gain coefficient, the Raman gain coefficient having its highest values along the optical axis of the fiber. Claim 2 depends from claim 1, and is therefore patentable over the cited art for the reasons described above. In addition, as described above, Siegman teaches away from doping the core to provide for SRS. Rice discloses a number of equations that have a Raman gain coefficient operand, but at no point does Rice describe incorporating radially dependent amounts of selected transparent oxides to provide a radially dependent control of the Raman gain coefficient, as recited in claim 2. Additionally, as described above, Rice discloses a Raman pump core, which receives a focused pump beam that that becomes evenly distributed in the Raman pump core to provide Raman gain for a signal wave in the single mode core (Rice, col. 3, ll. 40-50). The Raman gain is provided by the equation $(g_R*P_p)/A_p$, where g_R is the Raman gain coefficient, P_p is the pump beam power, and A_p is the cross-sectional area of the pump core (Rice, col. 3, ll. 46-48). Rice thus teaches that the gain is uniformly distributed, and therefore

constant, across the entire cross-sectional area of the Raman pump core. Accordingly, Rice does not teach or suggest radially dependent control of the Raman gain coefficient, as recited in claim 2. In addition, because the Raman gain occurs through the SRS process in the Raman pump core, the teachings of Rice suggest that Raman gain is greater in the Raman pump core than in the single mode core at the optical axis. Therefore, Rice does not teach or suggest that the Raman gain coefficient has its highest values along the optical axis of the fiber, as recited in claim 2. Accordingly, neither Rice nor Siegman, individually or in combination, teach or suggest claim 2. Withdrawal of the rejection of claim 2, as well as claims 3-5 which depend therefrom, is respectfully requested.

Claim 3 recites that the dopant that affects the Raman gain coefficient is germanium oxide. Neither Rice nor Siegman describe the use of germanium oxide as a dopant to affect Raman gain coefficients in a multimode optical fiber. Accordingly, neither Rice nor Siegman, individually or in combination, teach or suggest claim 3. Withdrawal of the rejection of claim 3 is respectfully requested.

Claim 4 recites that the Raman gain coefficient profile has a generally parabolic shape with a peak coinciding with the optical axis of the fiber. As described above with regard to claim 2, Siegman teaches away from doping the core to provide for SRS, and Rice does not teach or suggest that the Raman gain coefficient has its highest values along the optical axis of the fiber. Accordingly, neither Rice nor Siegman, individually or in combination, teach or suggest that the Raman gain coefficient profile has a generally parabolic shape with a peak coinciding with the optical axis of the fiber, as recited in claim 4. Withdrawal of the rejection of claim 4 is respectfully requested.

Claim 5 recites that dopant concentrations are selected to provide a measure of independent control over the Raman gain coefficient profile. As described above regarding claim 1, neither Rice nor Siegman teach or suggest doping a core to provide a Raman gain coefficient profile. Accordingly, neither Rice nor Siegman teach or suggest that dopant concentrations are selected to provide a measure of independent control over the Raman gain

coefficient profile, as recited in claim 5. Withdrawal of the rejection of claim 5 is respectfully requested.

For the reasons described above, claims 1-5 should be patentable over the cited art. Accordingly, withdrawal of this rejection is respectfully requested.

II. Rejection of Claims 6-9 and 11 Under 35 U.S.C. §103(a)

Claims 6-9 and 11 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Rice and further in view of Siegman and WO 02/50964 A2 to Clarkson ("Clarkson"). Withdrawal of this rejection is respectfully requested for at least the following reasons.

Claim 6 recites, in pertinent part, a multimode fiber comprising a core having radially dependent amounts of dopant materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes. For substantially the same reasons as given for claim 1, neither Rice nor Siegman teach or suggest claim 6. The addition of Clarkson does not cure the deficiencies of Rice nor Siegman to teach or suggest claim 6. Clarkson teaches a fiber-based optical source with a high power laser diode stack pump source shaped into an intense beam by focusing and light concentrating elements (Clarkson, Abstract). However, the combination of Rice, Siegman, and Clarkson does not teach or suggest a multimode fiber comprising a core having radially dependent amounts of dopant materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, as recited in claim 6. Withdrawal of the rejection of claim 6, as well as claims 7-10 which depend therefrom, is respectfully requested.

Claim 7 recites that the Raman gain coefficient profile has a generally parabolic shape with a peak coinciding with the optical axis of the fiber. For the reasons described above regarding claim 4, claim 7 should be allowed over the prior art. The addition of Clarkson does not cure the deficiencies of Rice and Siegman to teach or suggest claim 7. Withdrawal of the rejection of claim 7 is respectfully requested.

Claim 11 has been amended to correct an antecedent problem and recites, in pertinent part, a method of generating a diffraction limited high brightness laser beam in a multimode fiber

comprising providing a core with radially dependent amounts of at least one dopant that provides a Raman gain index profile with maxima coinciding with an optical axis of the fiber, and in the fiber, favoring the lowest order mode by providing maximum Raman gain along the optical axis, and discriminating against higher order modes. For substantially the same reasons as given above for claims 1, 4, and 6, claim 11 should be allowed over the cited art. Withdrawal of the rejection of claim 11 is respectfully requested.

For the reasons described above, claims 6-9 and 11 should be patentable over the cited art. Accordingly, withdrawal of this rejection is respectfully requested.

III. Rejection of Claim 10 Under 35 U.S.C. §103(a)

Claim 10 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Rice, Siegman, Clarkson, and further in view of U.S. Publication No. 2003/0161361 to Paldus, et al. ("Paldus"). Withdrawal of this rejection is respectfully requested for at least the following reasons.

Claim 10 depends from claim 6, and should be allowable for at least the reasons described above regarding claim 6. The addition of Paldus does not cure the deficiencies of Rice, Siegman, and Clarkson to teach claim 6. Paldus teaches a laser tuning mechanism that embodies spectrally dependent spatial filtering (Paldus, Abstract). However, the combination of Rice, Siegman, Clarkson, and Paldus, individually or in combination, does not teach or suggest a multimode fiber comprising a core having radially dependent amounts of dopant materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, as recited in claim 6, from which claim 10 depends. Accordingly, claim 10 should be patentable over the cited art. Withdrawal of the rejection of claim 10 is respectfully requested.

III. New Claims 12-17

New claim 12 depends from claim 1 and recites that the radially dependent amounts of dopant materials comprise a minimum amount of dopant material near an interface between the

core and the cladding region with a gradual transition to a maximum amount at the optical axis. The cited art, individually or in combination, does not teach or suggest new claim 12. Consideration and allowance of new claim 12 is respectfully requested.

New claim 13 depends from claim 1 and recites that the fiber is configured to provide higher Raman gain along the optical axis for multimode light launched into the fiber. The cited art, individually or in combination, does not teach or suggest new claim 13. Consideration and allowance of new claim 13 is respectfully requested.

New claim 14 depends from claim 6 and recites that the radially dependent amounts of dopant materials comprise a minimum amount of dopant material near an interface between the core and the cladding region with a gradual transition to a maximum amount at the optical axis. The cited art, individually or in combination, does not teach or suggest new claim 14. Consideration and allowance of new claim 14 is respectfully requested.

New claim 15 depends from claim 6 and recites that the fiber is configured to provide higher Raman gain along the optical axis for multimode light launched into the fiber. The cited art, individually or in combination, does not teach or suggest new claim 15. Consideration and allowance of new claim 15 is respectfully requested.

New claim 16 depends from claim 11 and recites that launching the pump power into one end of the multimode fiber comprises launching a multimode laser input into one end of the multimode fiber. The cited art, individually or in combination, does not teach or suggest new claim 16. Consideration and allowance of new claim 16 is respectfully requested.

New claim 17 depends from claim 11 and recites incorporating a minimum amount of dopant material near an interface between the core and a cladding region with a gradual transition to a maximum amount at the optical axis. The cited art, individually or in combination, does not teach or suggest new claim 17. Consideration and allowance of new claim 17 is respectfully requested.

CONCLUSION

In view of the foregoing remarks, Applicant respectfully submits that the present application is in condition for allowance. Applicant respectfully requests reconsideration of this application and that the application be passed to issue.

Please charge any deficiency or credit any overpayment in the fees for this amendment to our Deposit Account No. 20-0090.

Respectfully submitted,

Date 1/25/06

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